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Marthamyces coronadoae sp. nov. in a *Fagus grandifolia* subsp. *mexicana* forest from Hidalgo State, México

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Abstract—*Marthamyces coronadoae* is described as a new species from a relict forest of *Fagus grandifolia* subsp. *mexicana* in México. The specimens were collected on fallen and dead *Fagus* leaves in La Mojonera (in Zacualtipán municipality, Hidalgo State, México). This species is characterized by an apothecium opening by 4–5 pruinose and brownish beige teeth, a pale grey to pale yellow hymenial surface, and ascospores that are curved or coiled when released. A key to species of *Marthamyces* that grow in America is presented.

Key words—*Leotiomycetes, Marthamycetaceae,* propoloid fungi, taxonomy

Introduction

Minter (2003) established *Marthamyces* (with *M. emarginatus* (Cooke & Massee) Minter as type species) to accommodate taxa with filiform ascospores placed in *Propolis* sensu Sherwood (1977). The genus includes species that grow on abaxial and adaxial surfaces of fallen and dead plant leaves throughout the world, mainly in tropical and subtropical regions (Johnston 2006). *Marthamyces* is characterized by its apothecial ascomata that are subepidermal, orbicular to polygonal, resembling small pustules, erumpent from the substrate surface, not associated with bleaching of the surrounding substrate, and lacking zone lines (Minter 2003, Johnston 2006). The genus is characterized macroscopically by apothecia that are deeply immersed within the host tissue and a hymenial surface that often appears pruinose due to the presence of small crystals

amongst the paraphyses (Johnston 2006). Microscopically, the ascospores are filiform, 0–3-septate, and with apical and basal gelatinous caps, and the paraphyses have short branches near apex, tapering or swelling, tangled or with several short, finger-like projections, either often intermixed with crystals, or coated with crystals and with the tips of the paraphyses sometimes embedded in brownish gel (Sherwood 1977, Johnston 2006). The genus was formerly placed in *Rhytismataceae*, *Rhytismatales*, but recent phylogenetic studies in *Leotiomycetes* placed *Marthamyces* and *Propolis* in a clade separate from the *Rhytismatales* (Hustad & Miller 2011, Lantz et al. 2011). In 2015, Baral et al. established a new family *Marthamycetaceae* to accommodate the propoloid fungi (Baral 2015) and included *Cyclaneusma*, *Marthamyces, Mellitiosporiella*, *Mellitiosporium*, *Naemacyclus*, *Phragmiticola*, *Propolina*, and *Propolis*.

In México, only *Marthamyces quadrifidus* (Lév.) Minter has been recorded (specimen CU-ME-317, as *Propolis quadrifida*, from Oaxaca state; Sherwood 1977). In 2012, on a field survey of the relict forest of *Fagus grandifolia* subsp. *mexicana* (Martínez) A.E. Murray in La Mojonera (municipality Zacualtipán, Hidalgo State), México, several fallen leaves were collected that bore apothecia of the fungus here described as a new species of *Marthamyces*.

Materials & methods

The La Mojonera relict forest of *Fagus grandifolia* subsp. *mexicana* (*Fagaceae*) covers 45 ha at 2597 m asl. Its "montane cloud forest" vegetation comprises three arborous strata: higher (20–40 m), medium (8–20 m), and lower (2–8 m), and the higher stratum is dominated by *Fagus*, associated with *Magnolia schiedeana*, *Clethra macrophylla*, several *Quercus* species, *Pinus greggii*, and *P. patula* (Alcántara & Luna-Vega 2001, Williams-Linera et al. 2003, Godínez-Ibarra et al. 2007). Our specimens are deposited in the Herbarium, Instituto Politécnico Nacional, Mexico City, México (ENCB). Longitude and latitude coordinates were obtained with GPS eTrex (Garmin). Colors are coded according to Kornerup & Wanscher (1978). Morphological examinations were conducted as outlined by Sherwood (1977) and Johnston (2006). Measurements of anatomical characters were taken from rehydrated tissues in 5% aqueous KOH and Melzer's reagent. The macro-photos were taken with a Nikon D7000 and the micrographs with a Sony DSC-WX350. The meanings of some terms are based on Ulloa & Hanlin (2012) dictionary.

Taxonomy

Marthamyces coronadoae Raymundo, R. Valenz. & Esqueda, **sp. nov.** Figs 1–19

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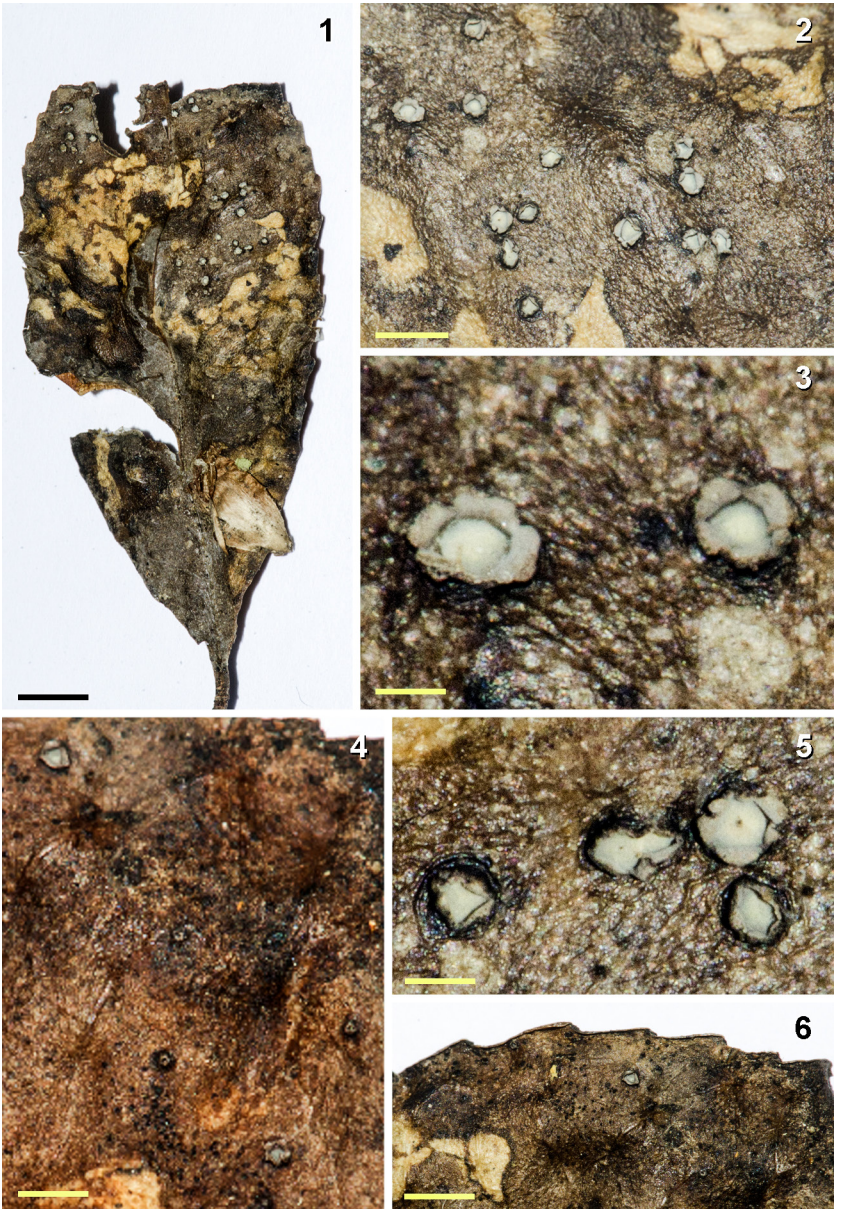
Differs from *Marthamyces quadrifidus* by its dark apothecial teeth, curved to coiled ascospores when released, and paraphyses with several short, finger-like projections.

Type: México, Hidalgo, municipality of Zacualtipán, Ejido "La Mojonera", 28°06′56″N 111°01′35″W, alt. 2550 m, 17 July 2012, T. Raymundo 4324 (**Holotype**, ENCB).



Figs 1–6: *Marthamyces coronadoae* (holotype, ENCB Raymundo 4324). 1 Abaxial side of leaf. 2. Pustules erumpent on surface of leaf. 3, 5. Apothecia opening in teeth. 4, 6. Adaxial side of leaf. Scale bars: 1 = 10 mm; 2, 4 = 3 mm; 3 = 500 µm; 5 = 1 mm. 6 = 5 mm.

Etymology: In honor of Sonoran researcher Ecol. Martha Coronado, a pioneer in fungal ecology in Sonora State.

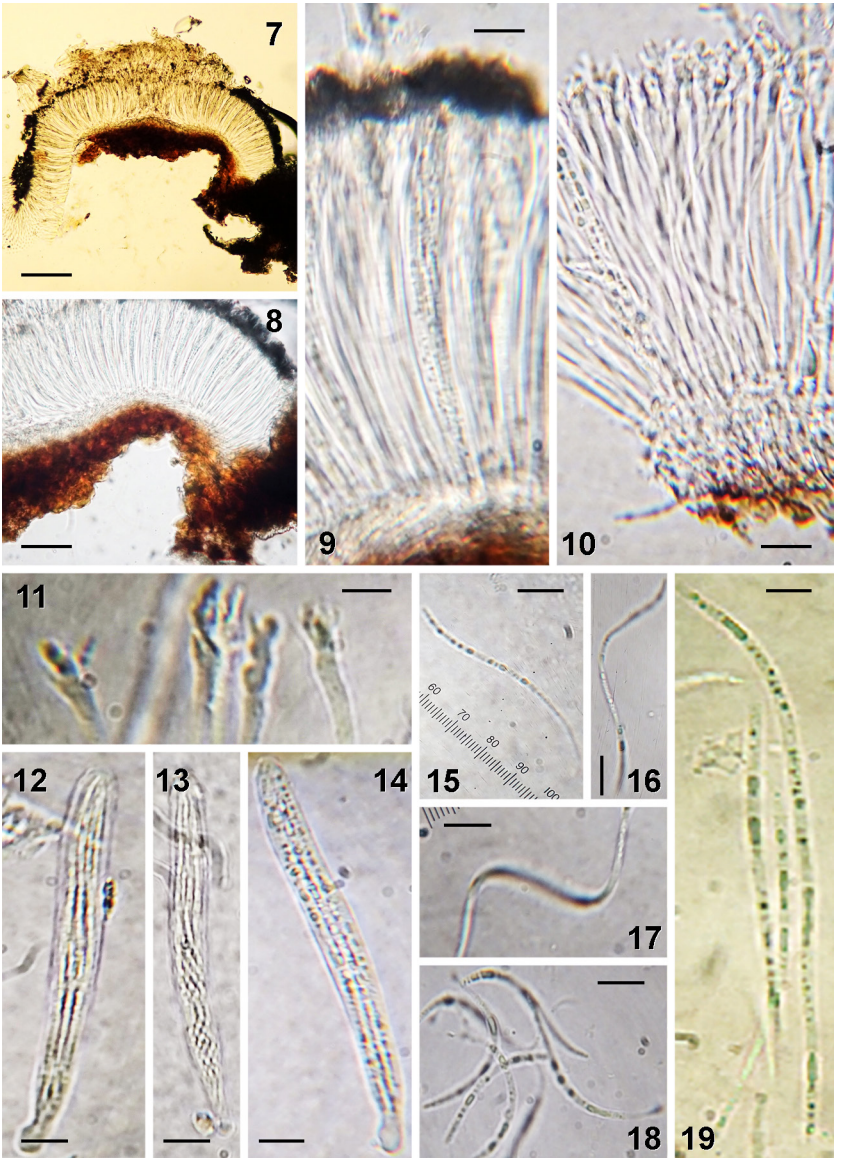
Apothecia 0.4–0.8 mm diam., on abaxial and adaxial surfaces of dead coriaceous leaves, subepidermal, resembling small pustules, visible initially as round black patches on leaf surface that raise as ascomata mature, erumpent from substrate surface, not associated with bleaching of host tissue, without zone lines, orbicular to polygonal, some rhomboid to pentagonal, others irregular in shape, superficial layer black in young apothecia, covering the hymenium, opening by 4–5 prominent, irregular, pruinose and brownish beige (6E3) teeth. Hymenium somewhat depressed below substrate level, pruinose, pale grey (1B1) to pale yellow (3A3) or pastel yellow (3A4) when fresh. Perimeter line absent. Subhymenium 10–15 µm thick, comprising small angular to globose cells, 1–2 µm diam., with hyaline walls. Paraphyses ≤100 µm long and 2 µm diam. (swelling slightly near apex ≤3 µm diam.) with several short, finger-like projections, at the apex coated with KOH-soluble crystals. Asci 70–90 × 6–8 µm, cylindric, with a foot-like base and a poorly developed basal stalk, tapering slightly at rounded apex, wall undifferentiated at apex, 8-spored. Ascospores slightly interwoven to irregularly arranged, or subparallel in the ascus, 60–74 (–80) × 1.6–2.4 µm, filiform, curved to coiled on release, hyaline in KOH, thin-walled, 0–1-septate, apical and basal gelatinous caps globose, 2.5–3 µm diam., gelatinous caps soluble in KOH.

Ecology & distribution—Found growing on fallen and dead leaves of *Fagus grandifolia* subsp. *mexicana* in montane cloud forest; known only from the type locality.

Comments—*Marthamyces coronadoae* is characterized by its orbicular to polygonal apothecia, the young apothecia erumpent through from a black covering layer, opening by 4–5 prominent, irregular and brownish beige teeth, its ascospores curved to coiled on release, 0–1-septate. *Marthamyces quadrifidus* is a similar species to *M. coronadoae*, but has 1–3-septate ascospores, more or less straight on release (Sherwood 1977, Cabarroi-Hernández et al. 2014) and it grows on several tropical and subtropical hosts (*Clusia*, *Eucalyptus*, *Lepidosperma*, *Mangifera*, *Myrtus*, *Rapanea*, etc.). *Marthamyces quercifolius* (Cooke & Ellis) Minter on *Quercus* and *Marthamyces phacidioides* (Fr.) Minter on *Ericaceae* and *Myricaceae* are also similar to *M. coronadoae*, but they differ by their 3-septate ascospores and their host preferences (Sherwood 1977).

Key to the species of *Marthamyces* in America

1. Ascospores 0–1-septate, apothecial teeth dark **2**
1. Ascospores 3-septate, apothecial teeth pale **3**



Figs 7–19: *Marthamyces coronadoae* (holotype, ENCB Raymundo 4324). 7, 8. Apothecium in transversal cut. 9. Crystals cover hymenial surface. 10. Paraphyses and asci on hymenial surface. 11. Apex of paraphyses with several short, finger-like projections. 12–14. Asci. 15–19. Ascospores. Scale bars: 7, 8 = 100 µm; 9, 10 = 10 µm; 11, 19 = 3 µm; 12, 15–18 = 5 µm. 13–14 = 8 µm.

2. On *Eucalyptus*, apothecia opening by 3–5 pruinose and black teeth,
hymenial surface pale grey,
ascospores straight or slightly curved on release ..... ***M. emarginatus***
2. On *Fagus*, apothecia opening by 4–5 pruinose and brownish beige teeth,
hymenial surface pale grey to pale yellow,
ascospores curved to coiled on release ..... ***M. coronadoae***
3. Tropical species, on *Clusia*, *Conocarpus*, *Mangifera*, *Myrtus*, *Rapanea*,
and many other hosts; hymenial surface pale grey ..... ***M. quadrifidus***
3. Temperate species, on *Quercus*, *Ericaceae*, and *Myricaceae;*
hymenial surface yellow **4**
4. On *Quercus*, apothecia amphigenous;
ascospores 50–65 × 1.5 µm, straight on release ..... ***M. quercifolius***
4. On *Ericaceae* and *Myricaceae*, apothecia hypophyllous;
ascospores 60–75 × 1.5–2 µm, straight on release ..... ***M. phacidioides***

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